

REMARKS

In view of the Office Action of February 14, 2006, claims 1-10 and 13-20 stand rejected. Claims 1-10 and 13-20 are pending in this application, whereas claims 11 and 12 have been previously cancelled.

Claims 1-4 and 13-20 stand rejected under 35 USC §103(a) as being unpatentable over Liu et al. (U.S. Patent No. 6,513,476). Claims 5-10 further stand rejected in further view of Zhu et al (6,182,630) and Paro (5,553,585). The Office Action states that Liu has been relied upon to show all structure, most notably the acute re-entrant angle and a recess.

Applicants reiterate their previous position that it is longstanding practice in the art of diesel engine engineering to provide diesel engines having piston diameters of more than 180 mm with an obtuse re-entrant angle of the crown bowl sidewall. Nevertheless, as discussed in Applicants' specification and as shown in prior art, an acute re-entrant angle has not been used in prior art diesel engine pistons having a diameter of over 180mm. (*See paragraph 10 of Applicants' Specification*). In their previous submissions, Applicants have noted the obstacles in designing an acute re-entrant angle for a piston having a diameter of over 180mm.

The office action further states that a change in size is generally recognized as being within the level of ordinary skill in the art and merely a design choice. Nevertheless, creating a larger piston bowl requires more than merely scaling a smaller piston bowl up. For example, Applicants' invention additionally includes a recess or a cooling chamber for cooling their larger sized piston bowl. For clarification, Applicants submit that the recess as previously claimed and referred to in the Amendment of

November 23, 2005 refers to the cooling chamber positioned below the piston squish face and in relation to the bowl sidewall portion. This cooling chamber is clearly shown in the figures (e.g., where the letters “110W” lie (not where they point to) in Fig. 2A or where the letters “A_{AI}” lie (not where they point to) in Fig. 5). The Office Action incorrectly refers to the recess as being part of the recess of the bowl. The Examiner will appreciate that the claims have been amended to clarify that the recess as referred to in the previous amendment is the cooling chamber positioned below the piston squish face and in relation to the bowl sidewall portion.

As discussed in the previous amendment, the importance of the recess or cooling chamber for larger diameter pistons is clear for Applicants’ present invention. For large-bore, medium speed diesel engines, there is generally no air swirl, and fuel spray jets generally do not impinge on the bowl. Accordingly, Applicants were required to invent a cooling chamber positioned below the piston squish face and in relation to the bowl sidewall in order to cool the piston. Small-bore and medium-bore, high speed engines as described in Liu do not have a recess or cooling chamber. Thus, in order to create a larger piston bowl, it is not obvious to simply scale a smaller piston bowl into a larger one. Instead, a cooling chamber has been invented by Applicants in order to overcome the smaller piston bowl’s shortcomings.

In yet another structural difference, none of the prior references show a crown bowl further including a substantially frustoconical inner surface extending from the maximum bowl depth to the centerline as claimed in claims 19 and 20. More specifically, as shown in the cross-sections of the multiple embodiments of the present invention, the bowl inner wall (e.g., W in Applicants’ Figures) is substantially linear.

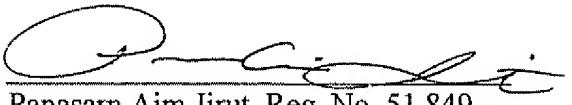
When rotating this substantially linear inner wall about the centerline C, a substantially frustoconical inner surface W is formed. The inner surface W extends from the maximum bowl depth MD to the centerline C. The Examiner will appreciate that Applicants have amended the claims to clarify such.

The office action states that the prior reference bowls show portions of an inner surface which is substantially straight. For support, the office action quotes Liu, "It is noted that the transition between RS1 and R1 is smooth and tangential . . ." Nevertheless, Applicants' claimed invention is not directed to the transition portion defining a frustoconical surface. Instead, as discussed above, Applicants' claimed invention is directed to the inner surface W extending between the maximum bowl depth MD and the centerline C being a frustoconical surface. The corresponding inner surface, RS1, in Liu is not substantially straight. Instead, Liu states that RS1 is a spherical surface. Col. 2, lns. 58-64 and as shown Fig. 1. The cross-section of the inner wall of Zhu as shown in Figure 3 is also generally curved. When rotated about their respective centerlines, the prior art inner walls form a generally spherical, hemispherical or semi-circular (*not* frustoconical) inner surface. Again, Applicants have amended the claims to clarify that the crown bowl further includes a substantially frustoconical inner surface extending between the maximum bowl depth and the centerline.

Accordingly, Applicants respectfully request withdrawal of the 103(a) rejections. In view of the foregoing, reconsideration and allowance of all claims are respectfully requested. The Examiner is invited to telephone the Applicants' undersigned attorney at (312) 236-8500 if any unresolved matters remain. The Commissioner is further

authorized to charge any applicable fees for filing this amendment to deposit Account No. 50-1039.

Respectfully submitted,
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